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(54) Portable building unit

(57) A portable building unit comprising, a rigid frame carrying wall (12a, 12b, 13a, 13b) and floor panels (26a, 26b), the frame comprising a rectangular floor sub-frame (e.g. 14b) comprising a pair of spaced parallel floor beams (20a) connected together by transversely extending floor joists (23a), a rectangular roof sub-frame (15a, 15b) comprising a pair of spaced parallel

roof beams (40a 40b) interconnected by transversely extending roof joists (41a, 41b, 42a, 42b) and a plurality of vertical columns (16a, 16b) extending between and interconnecting the floor (14b) and roof (15a, 15b) sub-frames, at least one side or end of the frame being provided with at least one panel (12a, 12b, 13a 13b) to provide an end or side wall, the or each panel (12a, 12b, 13a, 13b) comprising a structural sandwich comprising an outer metal sheet (70a, 70b) and an inner sheet (72a, 72b) sandwiching therebetween an infilling (73b) and at least one floor panel (26a, 26b) supported on said floor sub-frame (e.g. 14b).

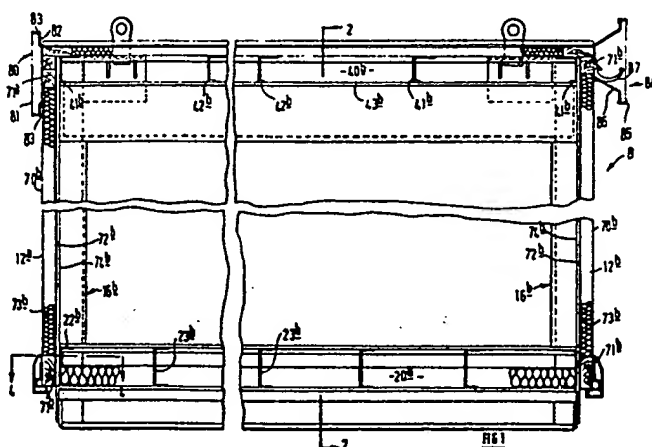


FIG 1

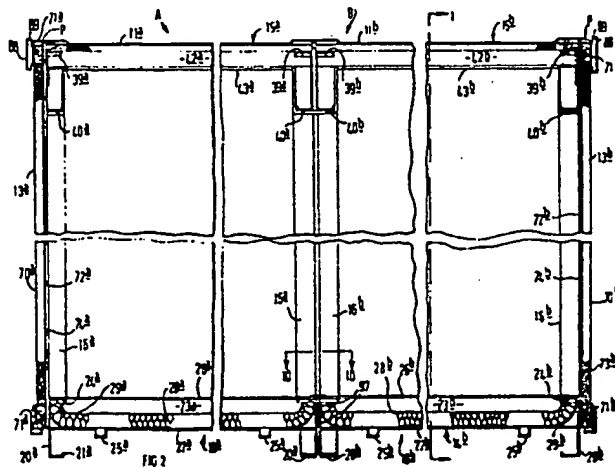
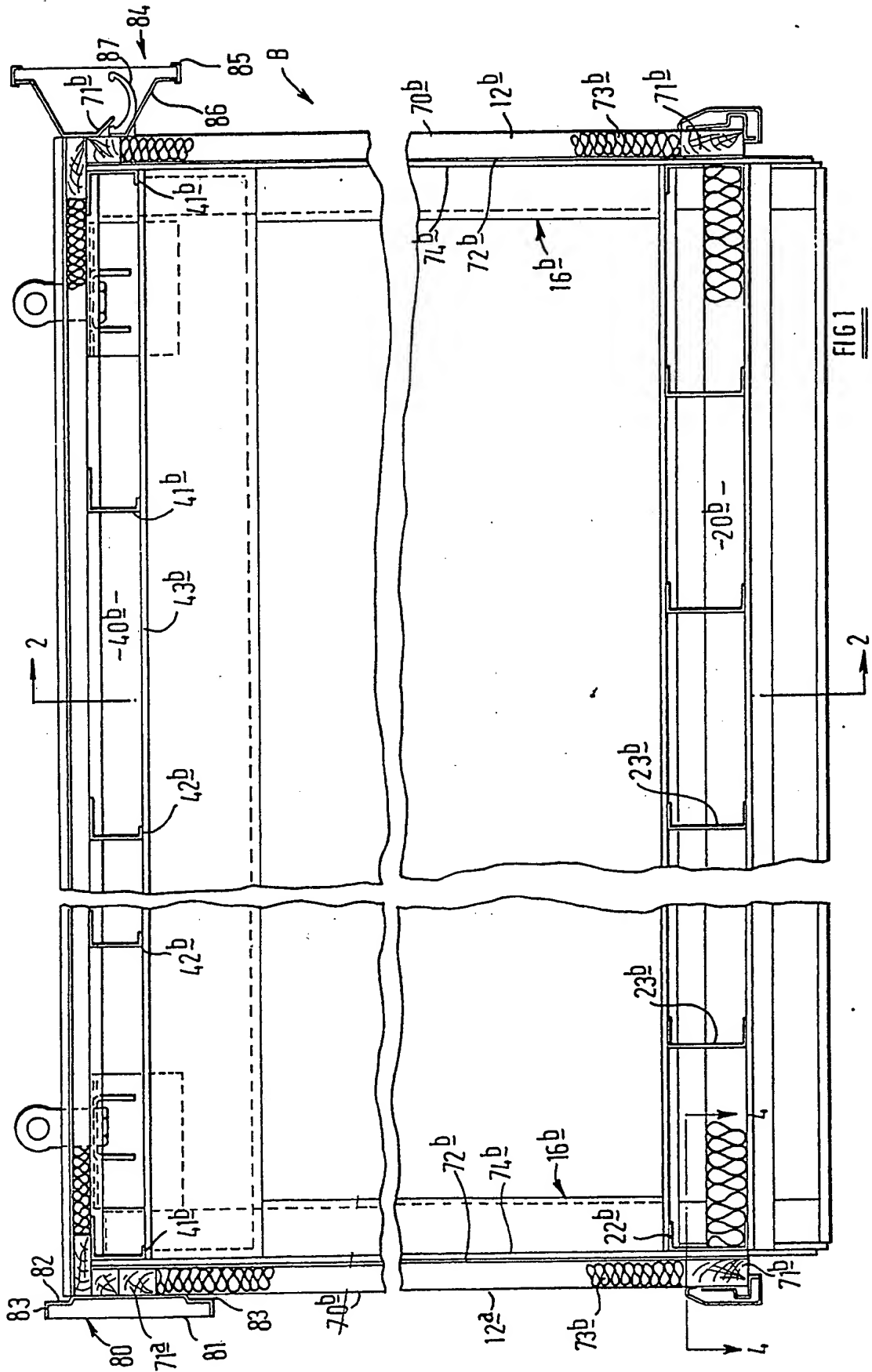


FIG 2

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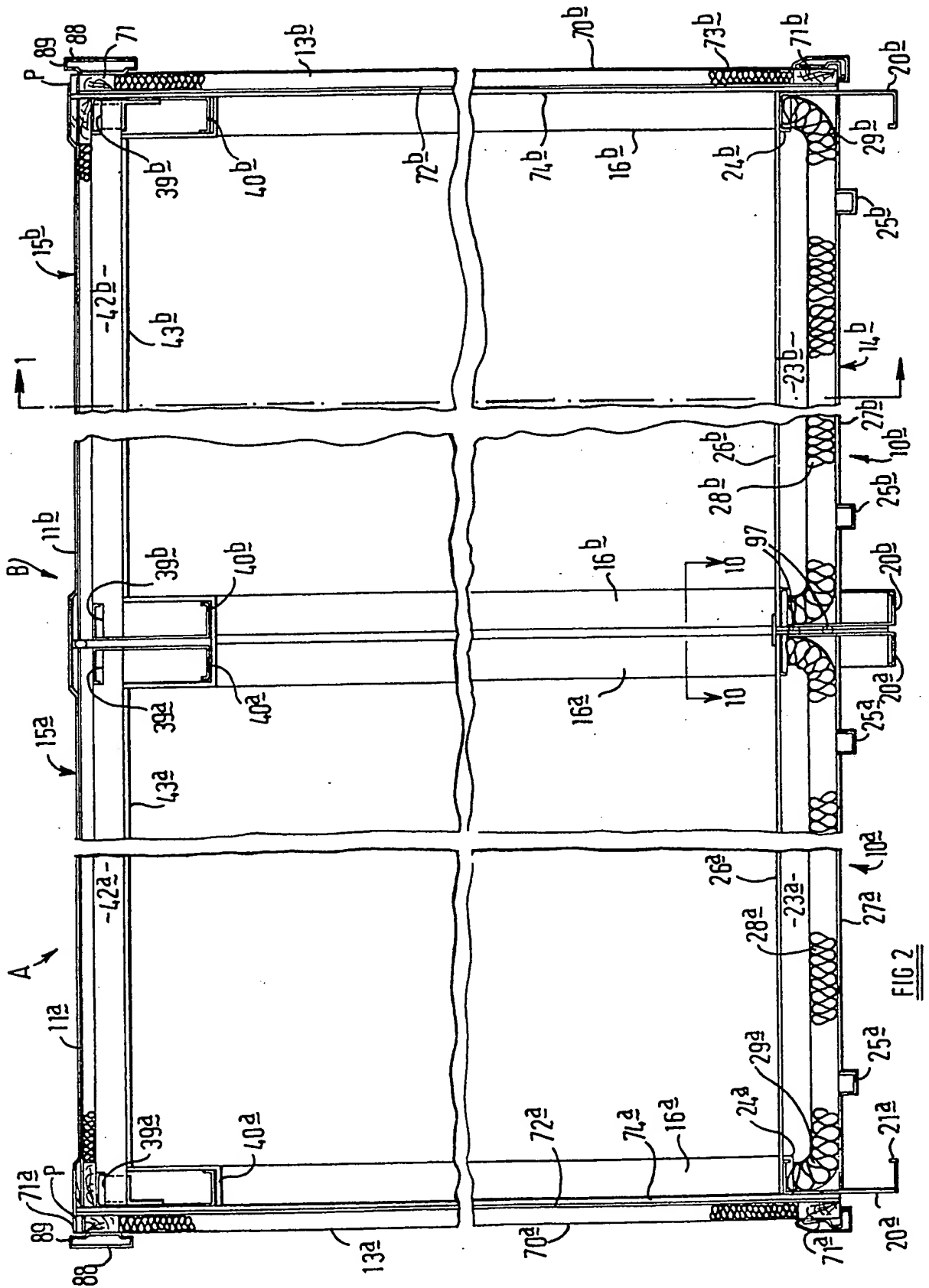
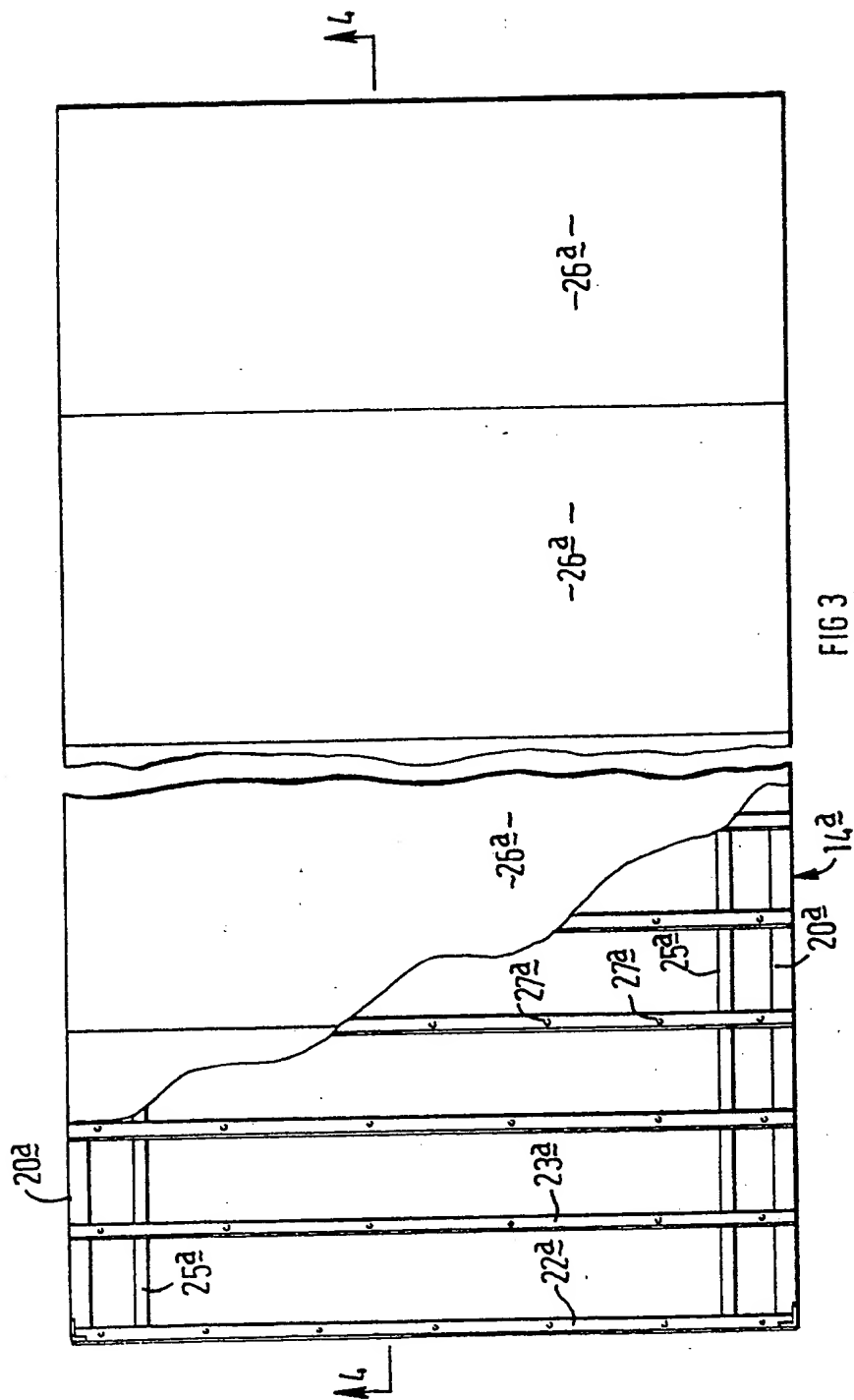


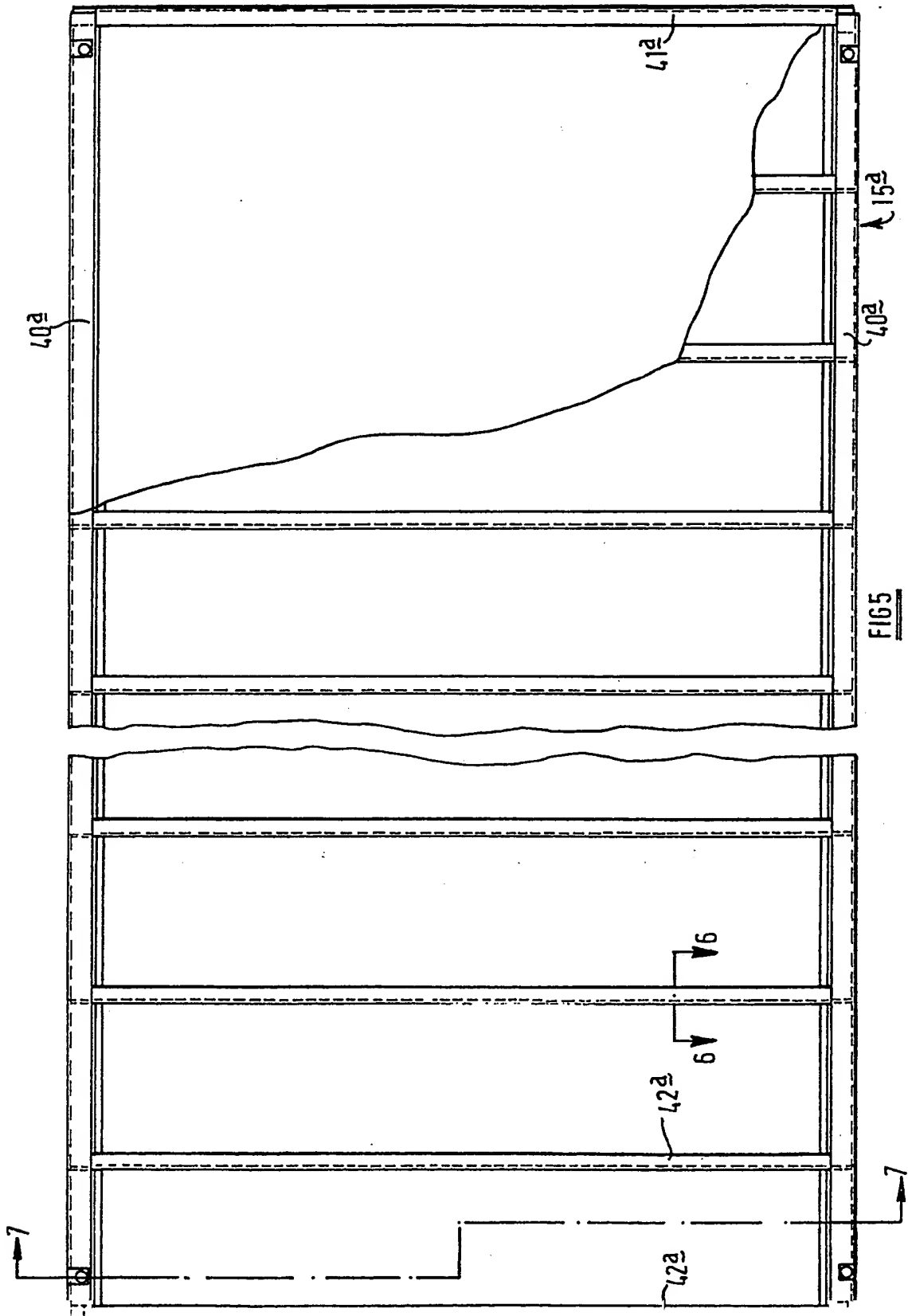
FIG 2

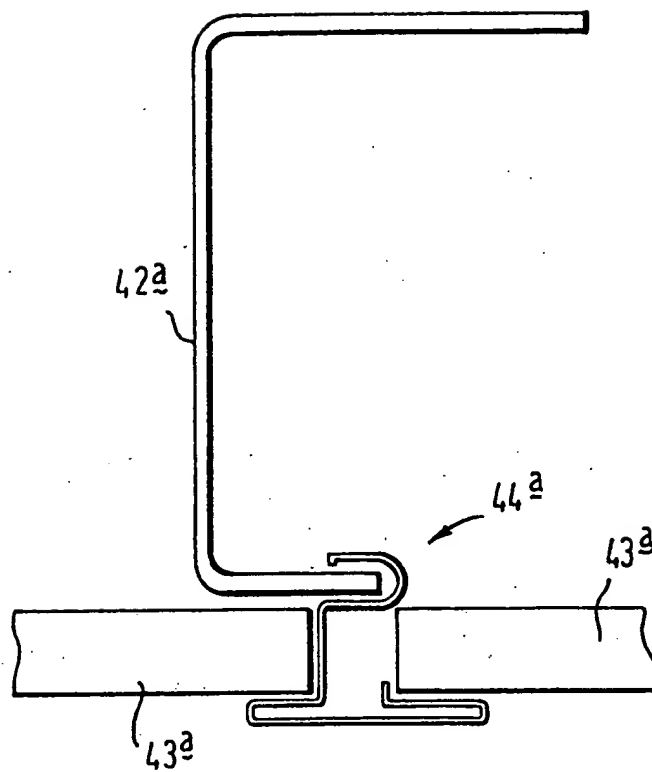
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12FIG 6

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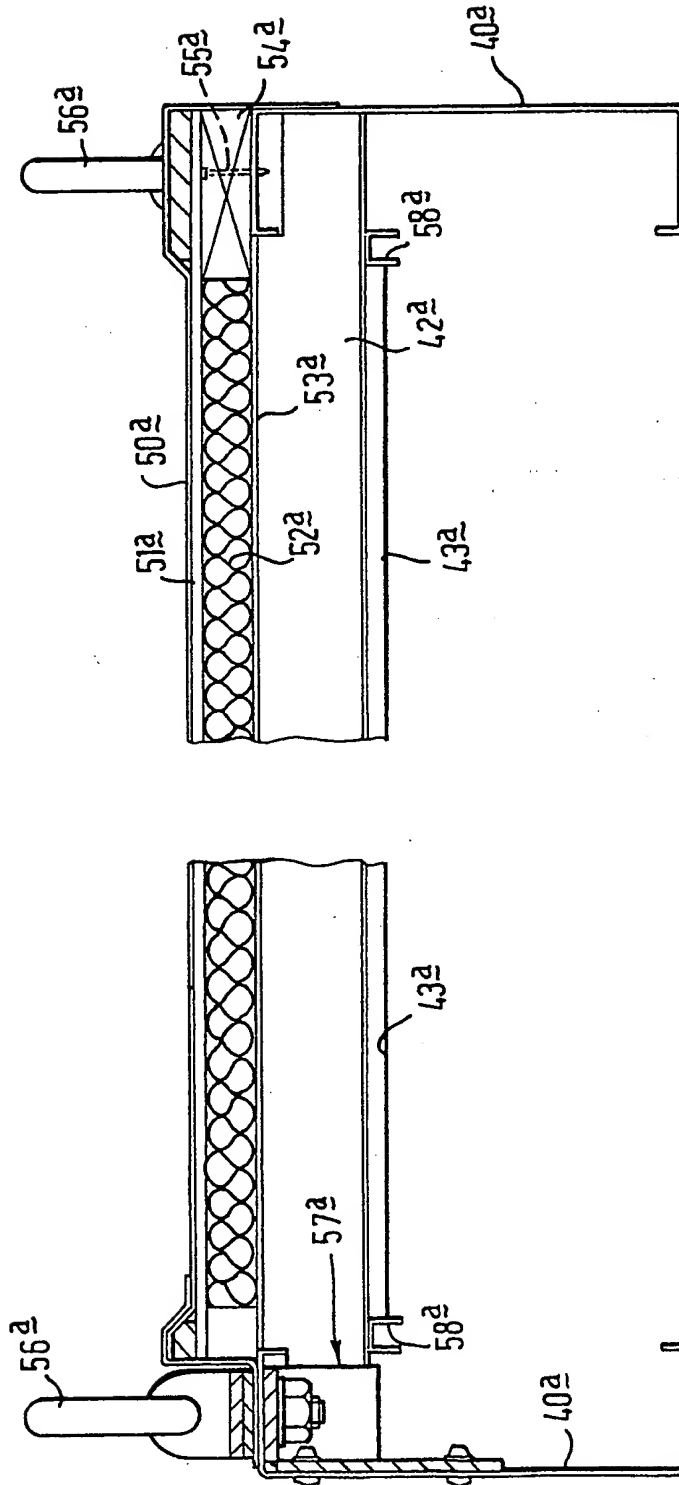
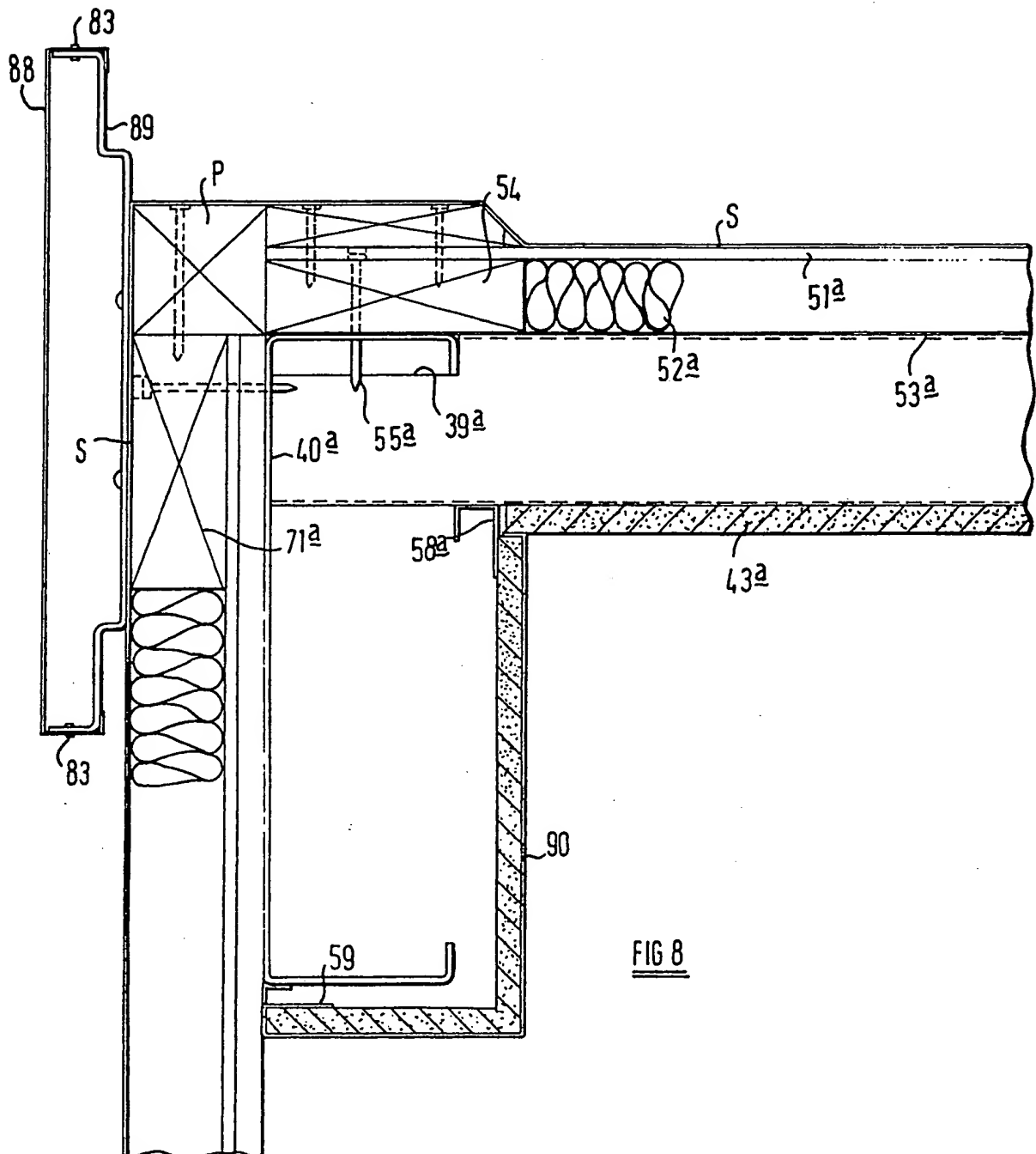
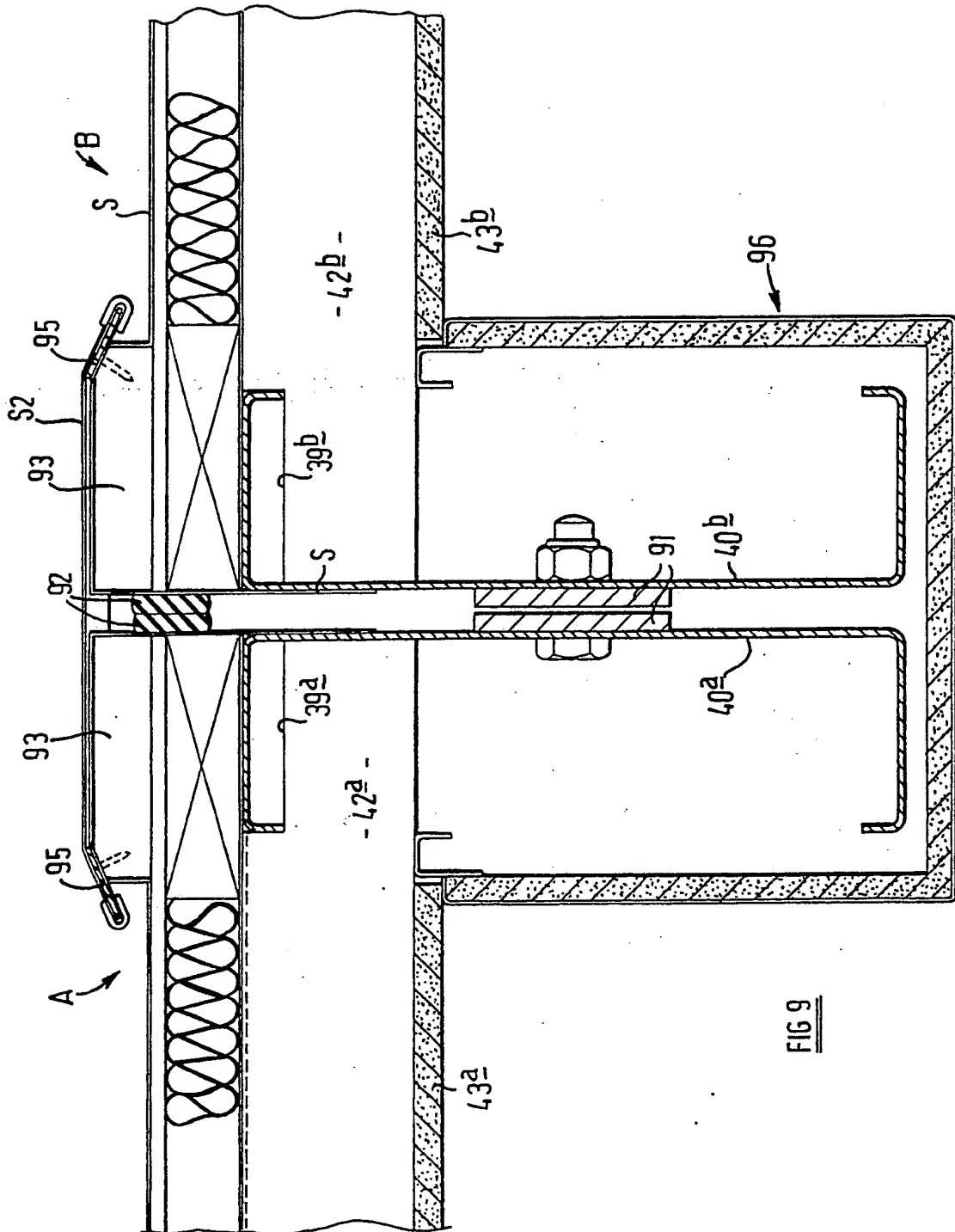
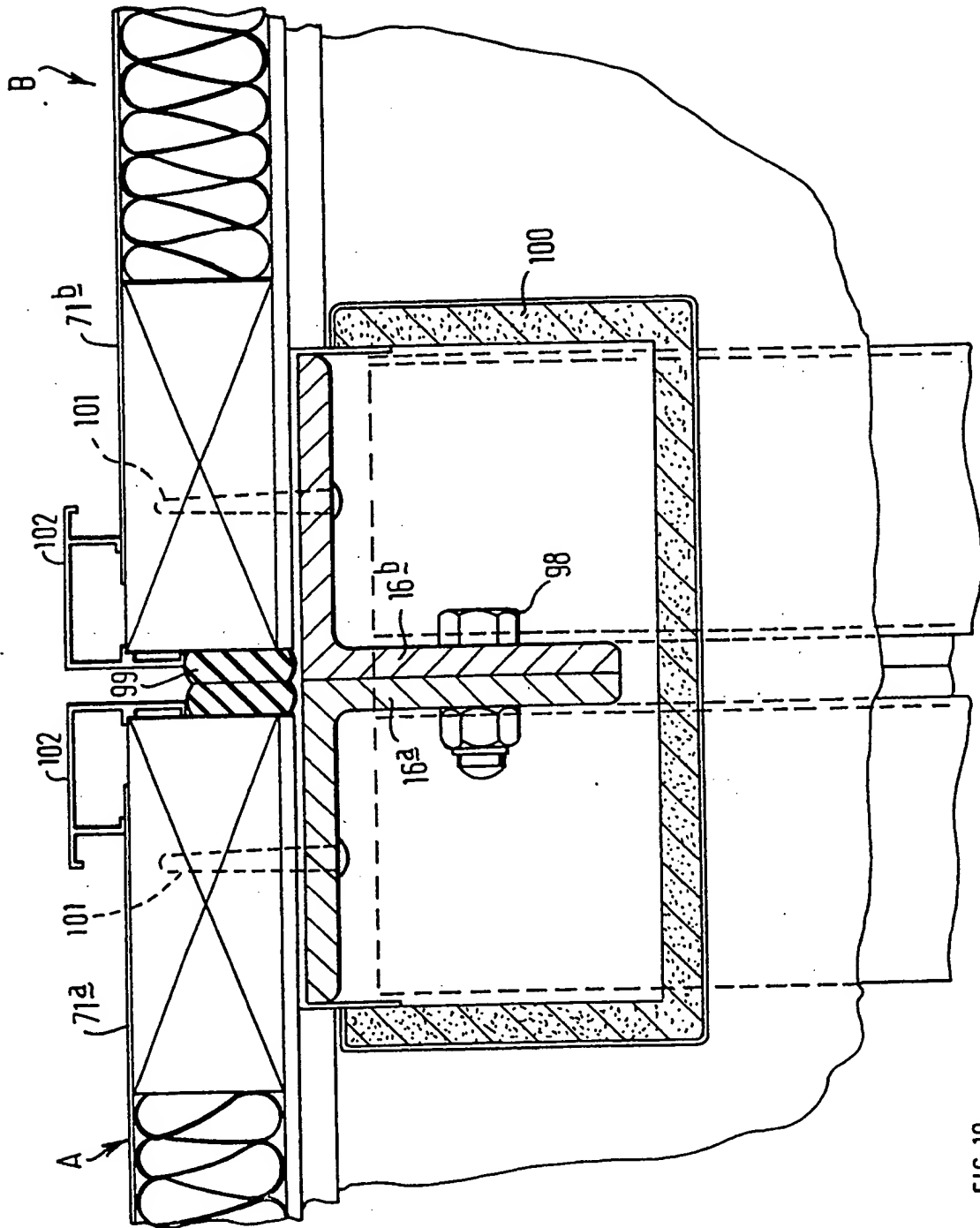


FIG 7

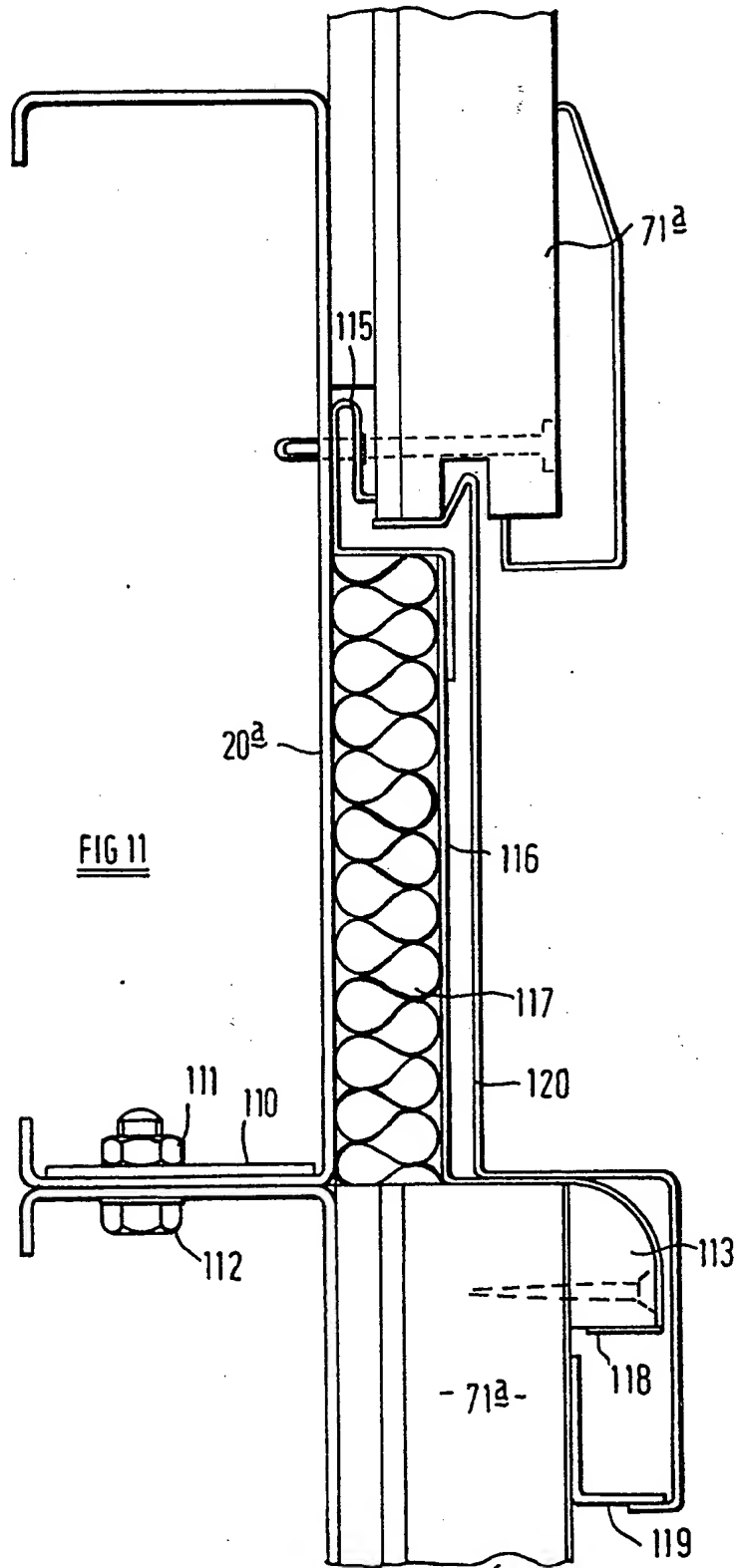
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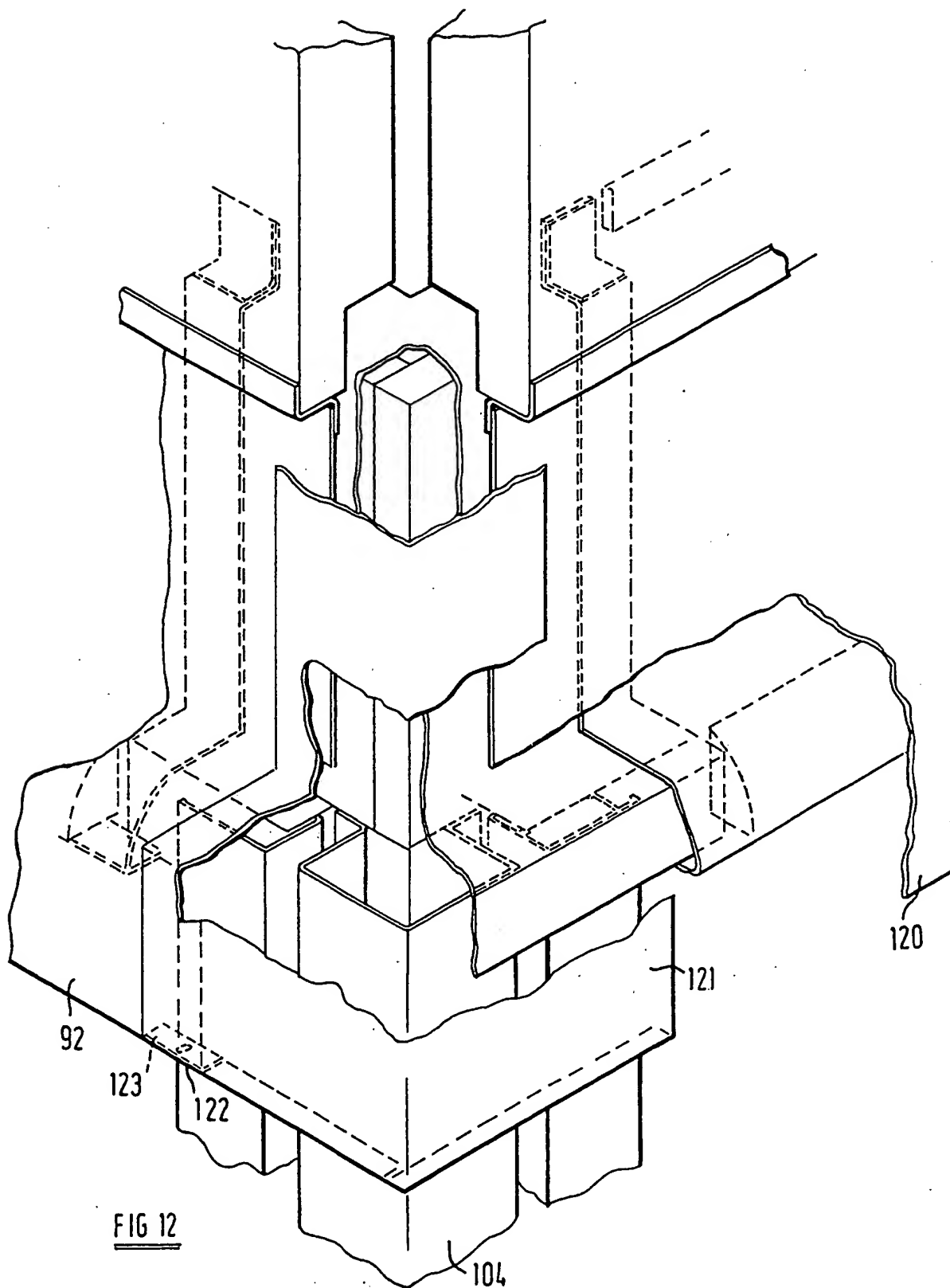


FIG 12

SPECIFICATION

Portable building unit

- 5 This invention relates to a portable building unit which is factory assembled and self-contained, designed for delivery to a prepared site in an assembled condition complete with floor, walls, and preferably all windows, doors and internal fittings. Such units may be assembled together to form a multi-unit building, provision for coupling the units together in the desired arrangement being built into each unit before the unit leaves the factory, so that the only assembly work required on site, is that of coupling the units together.

- In some cases the units will include end walls as well as side walls but alternatively, one or more of such end or side walls may be omitted to permit full width linking of the units. Such a portable building unit will be described hereinafter as "of the type described".

- An object of the invention is to provide a new and improved portable building unit of the type described.

- According to a first aspect of the present invention we provide a portable building unit of the type described comprising a rigid frame carrying wall and floor panels, the frame comprising a rectangular floor sub-frame comprising a pair of spaced parallel floor beams connected together by transversely extending floor joists, a rectangular roof sub-frame comprising a pair of spaced parallel roof beams interconnected by transversely extending roof joists and a plurality of vertical columns extending between and interconnecting the floor and roof sub-frames, at least one side or end of the frame being provided with at least one panel to provide an end or side wall, the or each panel comprising a structural sandwich comprising an outer metal sheet and an inner sheet sandwiching therebetween an infilling and at least one floor panel supported on said floor subframe.

- The infilling may be bonded to the outer sheet and may be a rigid foamed or expanded plastics material.

- At least one ceiling panel of plasterboard or other material may be supported from the roof sub-frame.

- At least one roof panel may be supported on the roof sub-frame and the or each roof panel may be adapted to carry a designed imposed load of at least 0.75KN/m^2 .

- Preferably, the or each roof panel comprises a plywood top skin and a reinforced foil faced membrane bottom skin on a wooden peripheral frame with rigid plastics foam material therebetween and a waterproof membrane on the outer surface of the top skin although if required, each roof panel may comprise a foil

permits a flush ceiling to be formed internally of the building rather than the beams protruding into the building as occurs in the former case. The or each floor panel may be

- adapted to carry a designed imposed load of at least 3KN/m^2 and may comprise plywood and an underdrawing of bitumen impregnated fibreboard thermal insulation laid between the joists, if desired, carpet vinyl or other floor covering may be bonded to the upper surface of the plywood.

The floor sub-frame may comprise a welded steel frame comprising channel side beams, channel joists and two steel runners.

- The roof sub-frame may comprise a welded steel frame comprising channel side beams and odd legged channel joists.

- The or each wall panel may comprise an external skin of plastic coated steel and an internal skin of hardboard, plasterboard or the like, for example 9mm thickness plasterboard, on a wooden frame and infilled with rigid polyurethane foam.

- The internal skin may be clad internally with plasterboard providing a fire resistance, for example 12.5mm Fireline plasterboard.

The columns may each comprise a steel angle member bolted to each roof and floor sub frame.

- According to a second aspect of the invention we provide two building units each according to the first aspect of the invention, one of said units being stacked on top of the other building unit. In this case the or each roof panel may be omitted from the lower of the two units and a fascia may be provided between the upper and lower units to protect the roof frame of the lower unit.

- A waterproof membrane may be stored in the floor sub-frame of the upper unit and moved into sealing relationship with the lower unit after stacking.

- The invention will now be described in more detail, by way of example, with reference to the accompanying drawings wherein:—

- Figure 1* is a longitudinal cross-sectional view through a portable building unit embodying the invention and taken on the line 1-1 of *Fig. 2*;

- Figure 2* is a section on the line 2-2 of *Fig. 1*;

- Figure 3* is a plan view, partly broken away, of a floor structure;

- Figure 4* is a section on the line 4-4 of *Fig. 1*;

- Figure 5* is a plan view partly broken away of a roof structure of the unit of *Fig. 1*;

- Figure 6* is a section on the line 6-6 of *Fig. 1*;

- Figure 7* is a section on the line 7-7 of *Fig. 1*;

- Figure 8* is a cross-sectional view of part of

part of Fig. 1 to an enlarged scale;

Figure 10 is a section on the line 10-10 of Fig. 2;

Figure 11 is a fragmentary vertical section through the long wall of two stacked units embodying the invention;

Figure 12 is a fragmentary perspective view of a corner of the stacked units of Fig. 11.

Referring to the drawings, particularly, Figs. 1 and 2, there is illustrated a building construction comprising two building units A, B linked together in side-by-side relationship. Each building unit is of generally rectangular box-like configuration and comprises a floor structure 10a, 10b, a roof and ceiling structure 11a, 11b, a pair of end walls 12a, 12b and a single side wall 13a, 13b. Of course, no side wall is provided on the sides of the units 11a, 11b, which are linked together.

If desired, a portable building unit embodying the present invention may comprise a single one of the two building units A, B and in this case the building unit would be identical to the unit A or B except that a second side wall would be provided.

It will also be appreciated that if desired, a building construction embodying the invention may comprise three or more building units and these building units may be linked together in side-by-side relationship or end-to-end relationship or in a combination of such arrangements. In each case, if desired appropriate end or side walls is or are omitted from the linked together units.

Alternatively, if desired, when two or more than two, of the building units are linked together, each building unit may be provided with all its side and end walls but with openings or doors provided in adjacent walls to permit intercommunication between the units. In certain circumstances it may, of course, be desired to provide a building construction comprising two or more units but with no communication between the units, or the communication may be provided by way of a relatively small opening or merely by way of a window.

In all the above cases however, the building unit or units concerned are identical to the two units 11a, 11b to be described hereinafter except for the differences identified above, namely the presence or absence of the relevant side and/or end walls.

Each building unit A, B comprises a rigid steel frame upon which floor, wall roof, and/or ceiling panels are mounted.

The frame comprises a floor sub-frame 14a, 14b and a roof sub-frame 15a, 15b, the sub-frames being interconnected by vertical columns 16a, 16b.

Referring now also to Figs. 3 to 6, the floor sub-frames 14a, 14b are identical. The or each sub-frame 14a, 14b is of welded construction and comprises a pair of side beams 20a, 20b of channel configuration having

inturned lips 21a, 21b at the free ends of the limbs of the channel. The side beams 20a, 20b are connected together by end joists 22a, 22b and intermediate joists 23a, 23b, all of the joists 22a, 22b, 23a, 23b having the same channel section configuration.

A portion 24a, 24b is cut out from the upper corner of each joist 23a, 23b to accommodate the top limb and downwardly turned lip 21a of the side beams 20a, 20b.

A pair of channel section runners 25a, 25b are welded to the underside of the joists 23a.

A floor deck comprising WBP plywood in the form of panels 26a, 26b is fastened to the joists 22a, 22b, 23a, 23b and side beams 20a, 20b with an underdrawing 27a, 27b of bitumen impregnated fibreboard, and mineral fibre insulation 28a, 28b is laid between the joists on top of the underdrawing 27a, 27b and folded up at its edges as indicated at 29a, 29b.

This construction is most clearly seen in Fig. 2.

The connection between the side beams 20a, 20b and the end joists 22a, 22b is illustrated in respect of the beams and joists 20a and 22a in Fig. 4 and comprises an angle section member 30a, to the lower end of which is welded a gusset plate 31a which overlies and is welded to the upwardly facing surface 32a of the lower limb of the beam 20a within the upturned lip 21a.

The upper and lower limbs of the end joist 22a are cut away as indicated at 33a to accommodate the end of the beam 20a and the web part 34a of the end joist 22a is welded to one limb 35a of the gusset plate 31a whilst the other limb 36a thereof is welded to the web of the beam 20a.

Referring now to Figs. 1, 2 and 5, each roof sub-frame 15a, 15b is of essentially similar construction to that of the floor, sub-frames 14a, 14b in that it comprises spaced parallel side beams 40a, 40b interconnected by end joists 41a, 41b and intermediate joists 42a, 42b which are welded to the side beams 40a, 40b in a similar manner that the joists are welded to the side beams of the floor frame. Again, appropriate cut outs 39a, 39b are provided at the upper corners of the joists. In addition, the connection between the side beams 40a, 40b and the end joists 41a, 41b utilises an angle member and a gusset plate as described in connection with the floor sub-frame.

The roof sub-frame differs from the floor sub-frame first in that the joists 41a, 41b and 42a, 42b have limbs of unequal length, the upper limb being longer than the lower limb, and secondly in the absence of runners. In addition, the spacing of the joists is different in that the distance between three joists in the roof frame is occupied by four joists in the floor frame.

If required, the main beams 40a may be

bowed before being internally and externally clad, as hereinafter described, so that when they are subjected to the static load imposed by the cladding, they straighten out to give a flat roof.

Plasterboard ceiling panels 43a, 43b are suspended by a clip means 44a shown in Fig. 6 comprising a one-piece cold rolled section which is clipped to the lower limb 46a of the associated joist 42a.

Referring now to Figs. 7 and 8, a roof deck 50a comprising a one-piece structural sandwich of WBP plywood 51a, rigid polyurethane foamed infilling 52a and a foil faced building membrane 53a on a peripheral wood frame 54a is nailed to the side beams 40a, and intermediate joists 42a, 42b by nails as indicated at 55a in Figs. 7 and 8. Sheets of weatherproof membrane such as HYPALON laminate is bonded over the whole of the upper surface of the roof decking 50a through which the nail connection is made.

To eliminate the beams 40a, 40b protruding into the building a steel roof frame may be inserted and the ply and Hypalon interchanged with plasterboard. The Hypalon has then to travel up the sides of the beam which are exposed to the outside. This has the effect of creating a flush internal ceiling and effectively insulating the structural members from fire, condensation and possible cold bridging.

The foam infilling 52a may comprise a panel or alternatively comprise a number of foam backed plasterboard tiles secured to joists with a row of tiles to be inserted on site at the joint between two units. The size of these ceiling tiles may be 600mm x 900mm, as large suspended plasterboard sizes shrink when exposed to fire and would need to be restrained at intermediate positions.

Four lifting eyes 56a are provided adjacent the corners of the roof frame and comprise eyebolt members which are bolted to a lifting plate assembly 57a bolted to the associated side beam 40a.

Channel members 58a are provided to provide an anchorage for trim to the side edges of the ceiling panels 43a.

Referring now again to Fig. 1, 2 and 4, the roof and floor sub-frames hereinbefore described are interconnected in spaced apart parallel relationship by columns 16a, 16b. As shown in Fig. 4, the or each column 16a, 16b is connected by bolts 60a to the web 61a of the limb at the associated end of the side beam 20a and also to the angle section member 30a along limb 36a. The other limb of each column 16a engages, but is not connected to, the web 34a of floor end joist 22a.

At its upper end, each column 16a is bolted in similar manner to the side beams 40a of

example 50mm, than the columns 16b so that a slight slope is provided to the roof structure to facilitate drainage.

Each side wall (12a, 12b) and end wall 70 (13a, 13b) of each of the units A, B is provided by a single structural panel comprising an outer plastics coated galvanised mild steel sheet 70a, 70b bonded to a softwood frame 71a, 71b with hardboard or 9mm thickness plasterboard internal panelling 72a, 72b nailed to the frame 71a, 71b with a rigid polyurethane foam infilling 73a, 73b therebetween. An internal lining of 12.5mm thickness "Fireline" plasterboard 74a, 74b is bonded to the hardboard 72a, 72b and also nailed to the frame 71a.

The frame for each side and end wall comprises top and bottom rails interconnected by vertical end rails and there being intermediate vertical rails therebetween. The spacing between the rails is such that every alternate rail is located at the junction between adjacent sheets of the plastics coated steel panels so that the remaining rails are located at the mid point of each panel.

The steel sheets are connected together by interlocking double folded seams as described in our previous Patent Specification No. 1,520,272.

The vertical end frame members are secured to the vertical columns 16a, 16b by screws driven from the interior of the unit, and the top and bottom rails are nailed into the associated side beams 20a, 20b, 40a, 40b of the floor and roof sub-frames or end joist members thereof.

The internal plasterboard lining panels 74a, 74b are secured to the intermediate rails by screw fasteners carrying a backing strip, driven into the panels at the line of meeting and the fasteners thus mount the backing strip which serves to clamp the edges of the panels 74a, 74b in position and also to provide support for a snap-on plastic trim which trims the connection between the panels.

The internal cladding of hardboard or plasterboard on the side panels is trimmed so that its upper surface decreases in height along the length of the side wall to correspond with the decrease in height of the roof from the higher to the lower end of the building.

Referring now to Fig. 1, a fascia arrangement 80 is shown at the high end of the unit B and comprises a channel shaped fascia panel 81 and a lipped channel configuration fascia mounting element 82 screwed to the peripheral frames of the wall and roof panels. The fascia panel 81 is riveted to the element 82 as indicated at 83.

At the low end, the unit is provided with a fascia arrangement 84 comprising a fascia panel 85 identical to the panel 81 and a fascia

which is fixed to the peripheral frames of the wall and roof panels so that the upper edge of the fascia panel 85 is in the same horizontal plane as the upper edge of the fascia panel 81.

5 In addition, channel section fascia panels 88 of the same configuration as the panels 81 extend along the length of the building and thus mask the fall in height of the roof. These longitudinally extending fascia panels 88 are
10 mounted on the unit by fascia mounting elements 89 identical to the elements 82 and are likewise fixed to the upper peripheral frame of the side walls to a timber packing member P located between the frames of the
15 side walls and roof.

The arrangement is best illustrated in Fig. 8 from which it can also be seen that plasterboard trimming within a plastic coated steel trim strip 90 is secured to the channel strip
20 58a and a further channel strip 59 provided between the plasterboard panels 43a of the ceiling and the lower limb of the roof beam.

Fig. 9 illustrates the connection between adjacent units A, B in the region of the
25 roof structures to a larger scale than in Fig. 2. It will be seen that the adjacent roof beams 40a, 40b are bolted together at spaced intervals along their length with interposed packing pieces 91 whilst a comprene seal 92 is
30 positioned between the adjacent end frames of the roof decking which, it will be noted, includes an edge trim strip 93. In addition, it will be noted that the HYPALON sheeting S is folded around the ends of the peripheral
35 frames and associated beams 40a and that protective trim strips 95 are secured to the trim strips 93 and provide an anchorage for a further strip of HYPALON S2 which is clipped to the ends of strips 95 and bridges the gap
40 between adjacent roof panels.

A trimming of plasterboard within a channel section plastic coated steel strip 96 is provided to trim the lower parts of the side
45 beams 40a, 40b which project below the level of the plasterboard ceiling panels 43a, 43b.

Referring now to Fig. 2, the connection between the units A, B at the floor calls for the provision only of comprene seal 97
50 between the webs of the adjacent floor beams 20a, 20b, no bolted connection between the floor beams being necessary.

Referring now to Fig. 10, it will be seen that the vertical columns 16a, 16b are bolted
55 together as indicated at 98 at a plurality of vertical positions along their height. A comprene seal 99 is provided between the adjacent vertical end frame members 71a, 71b, and the inwardly facing limbs of the angle
60 section members are trimmed by plastic coated steel encased plasterboard trimming 100. Also illustrated in Fig. 10 is the screwed connection, at 101, between the columns 16a, 16b and the vertical end frame members
65 71a, 71b.

An aluminium extrusion 102 is secured to each panel.

Referring now to Fig. 4, the corners of the units are trimmed by virtue of extruded aluminium alloy edge trims 103 screwed to the
70 vertical end members 71a and a steel corner trim member 104 is screwed to a corner fillet 105, itself screwed to the end frame members.

75 If desired, a unit embodying the invention can be stacked on top of another unit embodying the invention. This may be in addition to connecting units embodying the invention together in end-to-end and/or side-by-side
80 relationship.

When units are to be stacked then they are essentially as described hereinbefore and details of the stacking arrangement will be described hereinafter with reference to Figs. 11
85 and 12.

When units are to be stacked, the floor frame side beams 20a have bolted to the lower limb thereof captive plates 110 which have a nut 111 welded thereto.

90 When the units are stacked, by lifting one unit on top of the other by means of a crane or the like, the lower limbs of the floor frame beams 20a are supported on the upper limb of the roof frame beams 40a of the base unit
95 and bolts 112 are passed through apertures formed in the upper limbs of the beams 40a and tightened into a nut 111. Such bolted connection is provided at desired intervals along the lengths of the beams 20a, 40a.

100 Instead of the fascia panels 85, 88, a softwood beading 113 is screwed to the frame member by each of the side wall member 71a of the lower unit which are present and a rebate 114 is formed in the bottom
105 frame members 71a of the upper unit.

An anchor strip 115 is nailed to the associated side beam 20a and a strip of HYPALON 116 is thereby fixed to the beam 20a.

110 It should be noted that until the units are stacked, the HYPALON is coiled within the rebate 114 and taped in place but removed after the units have been stacked and after a layer of thermally insulating material 117 has been positioned beneath the anchor strip 115
115 and above the wall panel of the lower unit. The HYPALON is then folded down over the thermally insulating material 117 and over the beading 113 and folded under the lower surface thereof and secured in position by
120 nails 118.

Trim securing brackets 119 are nailed to the frame members 71a of the upper and lower units and then a trim member 120 is riveted to the brackets 119.

125 The embodiment described above is identical on the long and short walls except that on the short walls, the end joists are vertically spaced apart and thus to retain the insulating material 116 in position, a retaining bracket is
130 provided on top of the end joist to retain

the insulating material 116 in position.

At the corners, as shown in Fig. 12, a corner trim member 121 is secured in position by pop rivets 122 to an inwardly directed flange 123 of the trim member 120 and is fixed at its upper end to the trim member 120 where the members 121 and 120 overlap.

The member 121 also overlies the corner trim 104 of the lower unit.

The HYPALON strip has welded thereto a moulded corner-piece to maintain the continuity of the HYPALON strip at the corners.

The trim 121 has a short section of the corner trim material 104 rivetted thereto which is fitted within the corner trim 104 of the upper unit.

A unit embodying the invention may be of any desired dimensions but in the example illustrated above, the units are 7.32 metres long, approximately 2.94 metres wide, have a ceiling height of 2.5 metres or 3 metres.

If desired, the units may be of greater length, for example 9.76 metres and in this case, where the units are to be stacked, an intermediate vertical column is provided between the end columns of the corner unit and this may be conveniently located at 7.32 metres from one end.

By linking and stacking of appropriately dimensioned units, building constructions of varying configurations can be provided, for example, if desired, an upper storey may partly overhang an lower storey to provide a covered porch entrance, although if desired a building unit such as described may be utilised singularly.

A unit embodying the invention is preferably fully finished in that it is fitted with all necessary doors, windows, services, such as lighting points and the like.

The floor, walls and roof are fully insulated effectively eliminating the problems of "cold bridging" through steel components.

Units such as described require the minimum of site preparation, merely the provision of a flat load bearing surface or foundation pads for the floor sub-frame, or alternatively adjustable jack-mounted pins may be provided on the unit which can be arranged to rest on simple pads.

The units are constructed so that a building construction made of one or more of these units will comply with current German, French, Dutch and English building regulations such as, for example, fire resistance requirements, and various structural requirements are satisfied. In particular fire protection is afforded to the frame members by cladding them with plasterboard lined trims.

A steel framed internal or external staircase may be provided where units are stacked.

If the units are provided with double glazed windows, then the units may have the follow-

Various accessories may be provided in the pack such as for example, links to enable the units to be linked together, canopies to extend the building and other accessories as required.

CLAIMS

1. A portable building unit of the type described comprising a rigid frame carrying wall and floor panels, the frame comprising a rectangular floor sub-frame comprising a pair of spaced parallel floor beams connected together by transversely extending floor joists, a rectangular roof sub-frame comprising a pair of spaced parallel roof beams interconnected by transversely extending roof joists and a plurality of vertical columns extending between and interconnecting the floor and roof sub-frames, at least one side or end of the frame being provided with at least one panel to provide an end or side wall, the or each panel comprising a structural sandwich comprising an outer metal sheet and an inner sheet sandwiching therebetween an infilling and at least one floor panel supported on said floor sub-frame.

2. A building unit according to Claim 1 wherein the infilling is bonded to the outer sheet.

3. A building unit according to Claim 1 or Claim 2 wherein the infilling is a rigid foamed or expanded plastics material.

4. A building unit according to any one of Claims 1 to 3 wherein at least one ceiling panel is supported from the roof sub-frame.

5. A building unit according to Claim 4 wherein the ceiling panel is plasterboard.

6. A building unit according to any one of the preceding claims wherein at least one roof panel is supported on the roof sub-frame.

7. A building unit according to Claim 6 wherein the or each roof panel is adapted to carry a designed imposed load of at least 0.75 KN/m^2 .

8. A building unit according to Claim 7 wherein the or each roof panel comprises a plywood top skin and a reinforced foil faced membrane bottom skin on a wooden peripheral frame with rigid plastics foam material therebetween and a waterproof membrane on the outer surface of the top skin.

9. A building unit according to any one of the preceding claims wherein the or each floor panel is adapted to carry a designed imposed load of at least 3 KN/m^2 .

10. A building unit according to Claim 9 wherein the or each floor panel comprises plywood and an underdrawing of bitumen impregnated fibreboard thermal insulation laid between the joists.

11. A building unit according to Claim 10 wherein carpet, vinyl or other floor covering is bonded to the upper surface of the plywood.

12. A building unit according to any one

prising channel side beams, channel joists and two steel runners.

13. A building unit according to any one of the preceding claims wherein the roof sub-frame comprises a welded steel frame comprising channel side beams and odd legged channel joists.

14. A building unit according to any one of Claims 1 to 13 wherein the or each wall panel comprises an external skin of plastic coated steel and an internal skin of hardboard or plasterboard on a wooden frame and in-filled with rigid polyurethane foam.

15. A building unit according to Claim 14 wherein the internal skin is clad internally with plasterboard.

16. A building unit according to any one of the preceding claims wherein the columns each comprise a steel angle member bolted to each roof and floor sub-frame.

17. Two building units each according to any one of the preceding claims, one of said units being stacked on top of the other building unit.

18. Two building units according to Claim 17 wherein a facia is provided between the upper and lower units to protect the roof frame of the lower unit.

19. Two building units according to Claim 17 or Claim 18 wherein a waterproof membrane is stored in the floor sub-frame of the upper unit and moved into sealing relationship with the lower unit after stacking.

20. Any novel feature or novel combination of features, hereinbefore described and/or shown in the accompanying drawings.

21. A building unit substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

22. Two stacked building units substantially as hereinbefore described with reference to and as shown in Figs. 11 and 12 of the accompanying drawings.

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